$Mn_{3-x}Cu_xO_4$ (x = 1.0 – 1.5) Spinel Coatings on Metallic Interconnects for Solid Oxide Fuel Cells

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In recent years, solid oxide fuel cells (SOFCs) have received significant attention owing to an increasing need for efficient power generation. Especially, due to its high operating temperatures, the SOFC offers several potential advantages over polymer-based fuel cells, including fast electrode kinetics, high tolerance to typical catalyst poisons, internal reforming and direct use of hydrocarbon fuels. To increase the output voltage of the SOFC system, multiple cells are connected in electrical series using interconnects. In a stack, an interconnect electrically connects unit cells and separates fuel from oxidant in the adjoining cells.

Chromia-forming ferritic stainless steels are considered the most promising candidate alloys for SOFC interconnects due to their high electronic and heat conductivities, low cost, easy fabrication, and appropriate thermal expansion behavior. However, the exposure of these alloys to an oxidizing atmosphere at high temperatures can cause the growth of oxide scales, which leads to (*i*) a significant increase of interfacial resistance and (*ii*) a severe degradation in the cathode performance due to the poisoning effect of Cr species. A promising approach to overcome the issues is the surface modification of the metallic interconnects with conductive oxide coatings. For example, $(Mn,Co)_3O_4$ spinel coatings on metallic interconnects have been known to act as an effective barrier to oxygen inward and Cr outward diffusion [1].

Manganese-copper oxides, $(Mn,Cu)_3O_4$, are also of interest due to their excellent electrical properties. Given the high conductivity of $(Mn,Cu)_3O_4$, it is expected that the contact resistance could be further reduced by using $(Mn,Cu)_3O_4$ as a protective layer on metallic interconnects. In this study, nano-sized $Mn_{3-x}Cu_xO_4$ materials are synthesized by the Pechini method using citric acid. The materials with various Cu contents (x = 1.0 – 1.4) are prepared and sintered to study the effect of x on sintering characteristics, electrical and thermal expansion properties. By using the synthesized powder, furthermore, a thin and dense protective layer is fabricated on a metallic interconnect (Crofer 22 APU) by a slurry dip-coating method followed by multi-step heat-treatment. The oxidation experiments indicate that the area-specific resistance of the spinel-coated interconnect is strongly dependent on the Cu content. In addition, the loss of electrocatalytic activity of LSCF cathode due to Cr poisoning is evaluated as a function of time in the presence of the spinel-coated interconnects.

Reference

[1] N. Shaigana, W. Qu, D.G. Ivey, W. Chen, J. Power Sources 195 (2010) 1529.